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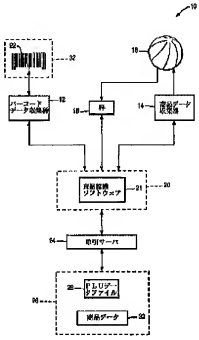
(54) ARTICLE DATA CONNECTOR AND ARTICLE RECOGNITION SYSTEM

(57) Abstract:

PROBLEM TO BE SOLVED: To speedily and securely recognize an article, without having to visually confirm the article or refer to an article code stored in a data file.

SOLUTION: This system is equipped with an article data collector 14, which has minimum spectrum distortion and this article data collector 14 includes an optical path tube having an entrance and an exit that part of light reflected by an article 18 passes through and a spectrometer, which is adjacent to the exit end of the optical path tube and devides part of the light to ones having plural wavelengths and generate signals related to those wavelengths for identifying the article.



CLAIMS

[Claim(s)]
[Claim 1]A commodity data collection machine comprising:
An optical-path pipe which has an entrance and an exit through which a part of light reflected from goods passes.
this -- spectrometer which adjoined this optical-path pipe exit that generates a signal for identifying goods in question related with said wavelength while dividing a part of lights into two or more wavelength.

[Claim 2]The commodity data collection machine comprising according to claim 1:
This spectrometer is a linearity variable filter.
A photodetector array made to adjoin a linearity variable filter.

[Claim 3]The commodity data collection machine according to claim 1, wherein this optical-path pipe contains a cylinder in the air.
[Claim 4]The commodity data collection machine according to claim 3, wherein this optical-path pipe contains an inner surface and contains a reflecting layer on this inner surface further.
[Claim 5]The commodity data collection machine according to claim 1, wherein this optical-path pipe contains an optical rod.
[Claim 6]The commodity data collection machine according to claim 5, wherein it has a refractive index and an outside surface with this optical-path pipe and this optical-path pipe contains a material layer whose refractive index is still lower than a refractive index of this optical-path pipe.
[Claim 7]The commodity data collection machine according to claim 1 by which a lens which focuses in a part of light being included in an entrance end of this optical-path pipe that adjoins an entrance end of this optical-path pipe.
[Claim 8]The commodity data collection machine comprising according to claim 1:
A light source which illuminates these goods.
A control circuit network which changes a signal into a digital signal while controlling this light source.

[Claim 9]A goods recognition system comprising:
A commodity data collection machine indicated to either of claims 1 thru/or 7.
A computer [reference spectrum / spectrum / of this digital signal] in order to identify these goods a control circuit network which changes a signal into a digital signal spectrum.

[Claim 10]A goods recognition system comprising:
A commodity data collection machine indicated to either of claims 1 thru/or 7.
A control circuit network which changes a signal into a digital signal with a certain spectrum.
A computer [spectrum / this / digital signal / reference spectrum / that these goods should be identified].

[Claim 11]A commodity data collection method comprising:
A step which illuminates these goods.
A step which mixes a part of light reflected from these goods.
this -- a step which divides a part of lights into two or more wavelength.
A step which generates a signal for identifying these goods related with wavelength.

[Claim 12]The commodity data collection method according to claim 11 containing a step which furthermore focuses reflected this light at an entrance of this optical-path pipe.
[Claim 13]The commodity data collection method according to claim 11, wherein this mixing step mixes light of various angles reflected via an optical-path pipe from these goods.
[Claim 14]The commodity data collection method comprising according to claim 11 to 13:
A step which changes into a digital signal with a certain spectrum a signal furthermore related with this wavelength.

A step [spectrum / this / digital signal / reference spectrum / that these goods should be identified].

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to a commodity data collection machine (produce data collector) and a goods recognition system (produce recognition system) especially about the device which checks out a product (processing of checkout, liquidation, stocktaking, etc.).

[0002]As for the bar code reader, in price balancing account of a retail store, and stocktaking management, the usefulness is known well. Since the barcode label is attached to almost all goods, the bar code reader can identify and record most goods in the usual dealings.

[0003]The typical goods which cannot be identified with a bar code reader and cannot be recorded are goods. It is because goods cannot usually carry out label attachment in a bar code. Things including the balance which measures the weight of goods as assistance which determines the prices of such goods are made to a bar code reader. However, identification of goods is the work those who still check out (henceforth an operator) have to work, and the operator must identify goods and, subsequently must input the identification code of goods manually. The identification method by an operator needs to refer to the bar code usually stored in the data file including the procedure which compares goods with the picture of goods visually, is slowness and fastness, and inefficiency. The method which an operator identifies visually tends to cause the error at a rate of 15% again.

[0004]So, it is desirable to give the goods recognition system which can make the minimum the procedure in which an operator identifies goods and includes it in dealings. When an operator adds up goods, in order to centralize cautions on one place of the liquidation counter with which the bar code reader has been arranged, it is desirable to give what combined the bar code reader and the goods recognition system.

[0005]This invention provides a new commodity data collection machine and a goods recognition system in light of the above-mentioned problems.

[0006]This commodity data collection machine contains the spectrometer which adjoined this optical-path pipe exit that generates the signal for identifying the goods in question related with the above-mentioned wavelength the optical-path pipe which has the entrance and exit through which a part of light reflected from goods passes while dividing the light of a part of above into two or more wavelength.

[0007]An optical rod may be sufficient as this optical-path pipe also at optical pie ** in the air.

[0008]The spectrometer mentioned as an example contains the photodetector array made to adjoin a linearity variable filter (linear variablefilter) and a linearity variable filter.

[0009]This commodity data collection machine contains the lens which adjoins the entrance end of an optical-path pipe and focuses to the entrance end of an optical-path pipe in a part of light further.

[0010]While being able to reduce the view field-of-view effect (field-of-view effect) by using such an optical-path pipe for this commodity data collection machine, The condensing efficiency (light collection efficiency) of the light which results from goods to spectrometer can be improved without increasing the incidence angle to spectrometer.

[0011]This invention is realized again also as a goods recognition system containing a computer [reference spectrum / spectrum / above-mentioned / digital signal] that goods in question should be identified the above-mentioned commodity data collection machine and the control circuit network which changes a signal into a digital signal with a certain spectrum.

[0012]The step which this invention is the method of collecting commodity data from goods if it sees from another aspect of affairs, and illuminates goods, It realizes as a method containing the step which mixes a part of light reflected from these goods, the step which divides this a part of light into two or more wavelength, and the step which generates the merchandise signal for identifying these goods related with this wavelength.

[0013]It is preferred that the light of various angles reflected from goods via an optical-path pipe is mixed while the reflected light focuses at the entrance of an optical-path pipe.
[0014]Since the signal relevant to wavelength identifies goods in question variously, it is changed into the spectrum of a digital signal and the digital signal can be compared with the reference spectrum for an arm.
[0015]The further advantage and the strong point of this invention will become clear to a person skilled in the art from the explanation about the example of the following related with this invention, said claim, and an accompanying drawing.
[0016]The goods check-out device 10 of drawing 1 to refer to contains the bar-code-data collection machine 12, the commodity data collection machine 14, and the balance 16.
[0017]The bar-code-data collection machine 12 reads the bar code 22 on the goods 32, and acquires the goods identification number relevant to the goods 32. This number is known also as an alias and a price search (price look-up, PLU) number. Arbitrary bar-code-data collection machines may be sufficient as the bar-code-data collection machine 12, and it contains the bar code optical scanner which uses the laser beam for reading a bar code. The bar-code-data collection machine 12 can be arranged in a checkout counter and on a checkout counter.
[0018]the commodity data collection machine 14 -- the goods 18 -- in addition to this, it has not bar-code-ized -- data is collected about arbitrary goods (henceforth non-bar code goods). Although such data contains color data and classification-by-color cloth data suitably, number method data, formed data, surface organization data (surface texture data), and aroma data can also be included. The reference commodity data 30 is collected and stored.
[0019]In the case of dealings, the commodity data collection machine 14 is put into operation with the start command of an operator which starts by placing the goods 18 on the balance 16, or is taken out from the transaction terminal 20.
[0020]The balance 16 determines the weight of the goods 18. Although the balance 16 is interlocked with the bar-code-data collection machine 12 and it operates, it can operate separately and can design equip separately. The balance 16 transmits the weight information of the goods 18 to the transaction terminal 20 so that the transaction terminal 20 can determine the prices of the goods 18 based on the weight information concerned.
[0021]Although the bar-code-data collection machine 12 and the commodity data collection machine 14 operate separately mutually, they can also unify both. The bar-code-data collection machine 12 is interlocked with the transaction terminal 20 and the dealings server 24, and operates.
[0022]In the case of the goods which attached the bar code, a goods identification number is acquired from the transaction terminal 20 bar-code-data collection machine 12, and it takes out a price corresponding from the PLU data file 28 via the dealings server 24.
[0023]In the case of the goods which have not been bar-code-ized, the transaction terminal 20 performs goods recognition software 21. This software acquires commodity-characteristics data from the commodity data collection machine 14. The goods 18 are identified by comparing collected commodity data with the commodity data in the commodity data in the goods data file 30, A goods identification number is taken out from the goods data file 30, the price corresponding to it is taken out from the PLU data file 28, and the whole goods 18 price is calculated using the weight obtained from the balance 16.
[0024]In the another example, identification of the goods 18 can be processed by the dealings server 24. The dealings server 24 receives the collected harvest characteristics, and compares it with the commodity data in the goods data file 30. Following identification, the dealings server 24 acquires the price to the goods 18, and transmits it to the transaction terminal 20.
[0025]The suitable storing medium 26 contains one or more hard disk drives. Although PLU file 28 and the goods data file 30 are stored in the storing medium 26 instead, each can put them on the transaction terminal 20 or the bar-code-data collection machine 12.
[0026]In order to help to identify goods properly, the goods recognition software 21 displays the further candidate goods, and presents attestation of an operator with them. The suitable goods recognition software 21 arranges candidate goods based on conformity probability, and displays them on the display for operators of the transaction terminal 20 by considering them as a text and/or a coloring image. The operator can make different selection by accepting the probable candidate or reversing the displayed candidate.

[0027]The commodity data collection machine 14 contains the light source 40, the optional alternative condensing lens 42, the optical-path pipe 44, the spectrometer 51, the control circuit network 56, the transparent window 60, and the housing 62 as the main portion so that it may turn out that drawing 2 is referred to.
[0028]The light source 40 generates the light 70. It is preferred for the suitable light source 40 to generate white light-spectrum distribution, and to have the range of 400 nm thru/or 700 nm. This range corresponds to the visible region of light.
[0029]As for the light source 40, it is preferred that one or more light emitting diodes (LED) are included. It is desirable to use LED which generates extensive spectrum white light which is manufactured at the NICHIA chemical industry company (Nichia Chemical Industires, Ltd). This is because it has a long life, interruption-to-service power consumption, high-speed turn-on time, and low operating temperature and good directivity. Although this alternative example contains LED which has various colors in a still narrower wavelength area, since it supplements with the spectrum of extensive spectrum white LED while equalizing the change within a spectrum, it is preferred to use these LED combining extensive spectrum white LED.
[0030]Although there are few advantages than extensive spectrum white LED, using the light source 40 of other forms by this invention is also considered. For example, therefore it has an extensive spectrum, tungsten halogen light can be used. However, the calorific value is large.
[0031]Although the LED group of a different color of plurality with various wavelength areas which are not superimposed can be used, when all the spectrum distribution has a gap, condensing performance lacks in desirable performance a little.
[0032]The condensing lens 42 and the optical-path pipe 44 reduce spectrum distortion by minimizing the view field-of-view effect.
[0033]The SUPEKU rotometer 51 contains the light separating element 52 and the photodetector array 54.
[0034]As for the light separating element 52, the light 76 is divided into the light 80 with a continious wave length zone in suitable this example. As for the light separating element 52, it is preferred that it is the linearity change filter (linear variable filter, LVF) 90 which is manufactured at the optical coating laboratory company. The linearity variable filter 90 gives the continuous-spectrum belt in a visible wavelength region (400 to 700 nm). As for the linearity variable filter 90, being equipped on the photodetector array 54 is preferred.
[0035]The photodetector array 54 generates the waveform signal 82 having contained spectrum data. The pixel of this array extracts the spatial specimen of the continious wave length zone generated by the light separating element 52, and generates the discrete-signal level of a lot. Although it is preferred that it is a complementary metal oxide semiconductor (CMOS) array as for the photodetector array 54, it may be a charge-coupled-devices (CCD) array.
[0036]The control circuit 56 controls operation of the commodity data collection machine 14, and produces the digitized commodity data waveform signal 84. The control circuit 56 contains an analogue-to-digital (A/D) converter for this purpose. A result with a satisfying 12-bit A/D converter with the 22 to 24 kHz rate of a specimen is produced.
[0037]The transparent window 60 can contain the antireflection layer for reducing reflection of the light 72. This reflection can add a background light noise to the light 74.
[0038]The housing 62 contains the light source 40, the condensing lens 42, the optical-path pipe 44, the spectrometer 51, the photodetector array 54, the control circuit network 56, and the transparent window 60.
[0039]An operator places the goods 18 on the window 60 when applying. The control circuit network 56 makes the light source 40 turn on. The light separating element 52 divides the catoptric light 74 into various wavelength, and generates the light 80 with a continious wave length zone. The photodetector array 54 generates the waveform signal 82 having contained commodity data. The control circuit network 56 generates the digitized commodity data 84, and sends this to the transaction terminal 20. The control circuit network 56 switches off a light source, and goes into a waiting state.
[0040]The transaction terminal 20 uses the commodity data within the digitized commodity data signal 84 in order to identify the goods 18. Commodity data consists of digital waveforms here, and the transaction terminal 20 compares this with the digitized waveform referred data stored in the goods data file 30. After identification, the transaction terminal 20 acquires the balance 16 to

weight for a unit price from the PLU data file 28 again in order to calculate all the fees of the goods 18. The transaction terminal 20 includes all the fees in dealings.
[0041]The spectrometer 51 provided with the linearity variable filter is shown in drawing 3 to refer to and 4 still in detail. One important feature of the spectrometer 51 possessing such a linearity variable filter is that the physical location which met the length of the linearity variable filter 90 corresponds to wavelength. This feature produces the view field-of-view effect.
[0042]If it says simply, the window of a limited size will cause distortion to the waveform measured. : which produces this distortion mainly by the following two factors -- from one on the one window 60 to various points on the linearity variable filter 90. To that the beam of light of various incidence angles of various distance comes (effect on radiant-quantities measurement), and 2 non-vertical-incidence beam of light, the filter zone wavelength of the linearity variable filter 90 should shift.
[0043]It can become very remarkable when such distortion has a small distance between the window 60 and the linearity variable filter 90. However, in order to obtain the optimal efficiency, for a miniaturization, it is desirable to make the linearity variable filter 90 approach the window 60, and to arrange it as much as possible. In order to reduce the view field-of-view effect, the distance between the window 60 and the linearity variable filter 90 must be time [what] larger than which size of the window 60 and the linearity variable filter 90.
[0044]This invention reduces the view field-of-view effect, therefore improves performance so that it may turn out that drawing 3 is referred to. The incidence angle of all the beams of light does not change, when passing the optical-path pipe 44, but the position in the outlet surface 92 of the optical-path pipe 44 of the beam of light by which it comes according to various incidence angles from arbitrary specific points of the window 60 is mixed (it is said that it mixes hereafter). If the optical-path pipe 44 is lengthened, mixing will improve. Although the optical path of the light 74 increases with an optical-path pipe, optical-path pipe 44 the very thing does not reduce efficiency. The physical size of the commodity data collection machine 14 is small made by bending the optical path of the light 74 by bending the optical-path pipe 44.
[0045]As shown in drawing 4, the optical-path pipe 44 can be used without the condensing lens 42 or it. Although the condensing lens 42 improves efficiency by what (henceforth a focus) the light 74 is condensed for by making the inlet surface 94 of the optical-path pipe 44 into a focal plane, it increases the range of the incidence angle to a linearity variable filter. However, for the mixed effect of the optical-path pipe 44, the view field-of-view effect in the outlet surface 92 of the optical-path pipe 44 is reduced, and gives an authentic smooth effect (pure smoothing effect) to a spectrum. This is equivalent to the degree of spectral solution image of the linearity variable filter 90 falling. If the spectrum of the goods 18 is smooth and continuous, slightly lower wavelength resolution will still be suitable, and it will obtain. A smooth effect is controllable by restricting maximum incident angle $theta_{max}$. For example, a maximum incident angle can be set as the allowable angle (acceptance angle) of the light separating element 52. In this case, a smooth effect will become what can be disregarded.
[0046]In the case of a certain window dimension, maximum incident angle $theta_{max}$ is restricted by the shortest distance permissible [from the window 60 to the linearity variable filter 90] in the example of drawing 3.
[0047]Maximum incident angle $theta_{max}$ is determined in the example shown in drawing 4 by the size of the lens 42, and the distance from the lens 42 to the entrance of the optical-path pipe 44.
[0048]Drawing 3 and the practical example of an optical-path pipe design over the example of 4 are shown in drawing 5 (A), drawing 5 (B), and 6. As shown in drawing 5 (A) and 5 (B), the printed circuit board 96 is equipped with the linearity variable filter 90, the photodetector array 54, and the optical-path pipe 44.
[0049]As shown in drawing 6, the optical-path pipe 44 is hollow and contains the two pieces 98 and 100 of a half rate. The inner surface of the pieces 98 and 100 of a half rate has required quality on optics, and often reflects light. This inner surface contains the reflecting layer 108 like reinforced aluminum. The conditions about an optical function are not required for an outside surface at all. The joint which the pieces 98 and 100 of a half rate connect should be vertically suitable to the lengthwise direction of the linearity variable filter 90 in order to make the minimum influence on the linearity variable filter 90.
[0050]Work can be easily performed by low cost. The pieces 98 and 100 of a half rate can be

formed by injection molding or compression molding. The reflecting layer 108 can be added using layer vacuum evaporation art.

[0051]As shown in drawing 6, two pieces of a half rate can be taken as the same machine part. The pin 102 and the hole 104 are arranged for slant. Since the pieces 98 and 100 of a half rate are maintained at one, an adhesive material can be used. Since the pieces 98 and 100 of a half rate are fixed to one, a screw thread can also be used. It inserts each other in the piece of a half rate, and shape can be added so that the piece of a half rate may be inserted in one and may be made. Each piece of a half rate has the hole 106 for fixing the optical-path pipe 44 to the printed circuit board 96. A hole may be twisted off and carried out.

[0052]In order to restrict maximum incident angle $theta_{max}$ to the linearity variable filter 90, optical-path pipe 44 the very thing is used for the 3rd example so that it may turn out that drawing 7 is referred to. Since the allowable angle of the linearity variable filter 90 is usually less than 20 degrees, the ground glass cylinder or rod (stick) can be used as the optical-path pipe 44, and the total internal reflection of the inner surface can be used. In this example, the optical-path pipe 44 is an optical-path pipe with refractive-index n_1, such as optical glass or an optical plastic, made from an optical material. The outside surface of this solid pipe is optically smooth, and another film 110 made from material of slightly low refractive-index n_2 is applied. If the angle is smaller than maximum incident angle $theta_{max}$ when a beam of light strikes upon the interface of two materials, total internal reflection of the beam of light will be carried out inside. $theta_{max}$ is following formula (measuring with degree) $theta_{max}=90-sin^{-1}(n_2/n_1)$ here.

It is come out and given. As for this, since all the beams of light with a bigger angle than $theta_{max}$ spread the above-mentioned boundary, absorbing by an optical absorption agent is preferred. Since the light of a big angle will be filtered with the optical-path pipe 44, in this example, the optical-path pipe 44 can be made to be able to approach the window 60 extremely, and can be arranged. Condensing efficiency is dramatically high.

[0053]About all three examples, the diameter of the optical-path pipe 44 should be slightly made larger than the length of the linearity variable filter 90. The linearity variable filter 90 should be made to approach the outlet surface 92 as much as possible, and should be made to adjoin the optimal.

[0054]The diameter D of :1 maximum-incident-angle $theta_{max}$ and 2 optical-path pipes 44 and 3 optical-path pipes crookedness factor (foldingfactor) N:(N-1) D/L=$tantheta_{max}$ as which optimal length L of the optical-path pipe 44 is determined by the following three factors [0055]The crookedness factor N of an optical-path pipe is a mixed rule of thumb. If a beam of light with the biggest incidence angle is crooked once [N-] within the optical-path pipe 44, the beam of light is mixed about N times in the outlet surface 92. There are N beams of light of various incidence angles mixed at the arbitrary points on the linearity variable filter 90 to the arbitrary points on the window 60. Mixing does not occur at all without the optical-path pipe 44. Only one beam of light advances at a certain specified point on the linearity variable filter 90 from the specified point with the window 60. The optical-path pipe crookedness factor exceeding the size 4 reduces this view field-of-view effect notably.

[0056]In the above-mentioned argument, the case of a distorted beam of light is also the right.

[0057]Although this invention was described specifically with reference to some suitable examples, various design variations and change are possible for this invention within the limits of the gist and the aforementioned application for patent.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The block diagram of the transaction processing system containing a goods recognition system is shown.

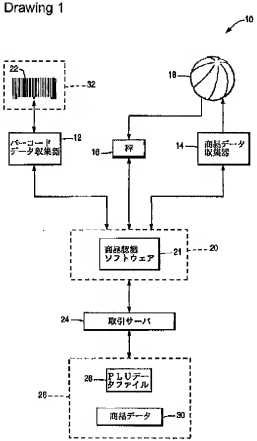
[Drawing 2]The block diagram of an example of a commodity data collection machine which collects spectrum data is shown.

[Drawing 3]It is the first diagram showing operation of the optical-path pipe formed in the commodity data collection machine.

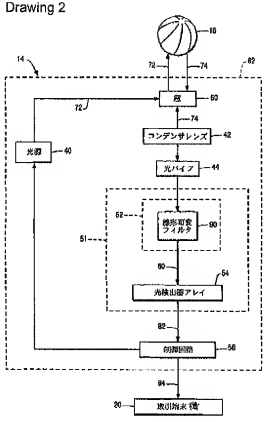
[Drawing 4]It is the second diagram showing the operation of the optical-path pipe provided with the condensing lens in a commodity data collection machine.
[Drawing 5]The side view and front view showing wearing of the optical-path pipe provided with spectrometer are shown.
[Drawing 6]The exploded view of the optical-path pipe in this invention is shown.
[Drawing 7]The optical-path pipe concerning the 3rd example of this invention is explained.
[Description of Notations]
12 Bar-code-data collection machine
14 Commodity data collection machine
16 Balance
18 Goods
20 Transaction terminal
21 Goods recognition software
24 Dealings server
26 Storing medium
28 PLU data file
30 Commodity data
40 Light source
42 Condensing lens
44 Optical-path pipe
51 Spectrometer
52 Light separating element
54 Photodetector array
56 Control circuit network
60 Transparent window
62 Housing
72 Light
74 Catoptric light
90 Linearity variable filter
80 Continious wave length band lights
82 Waveform signal
84 Digital commodity data
90 Linearity variable filter
92 The outlet surface of the optical-path pipe 44
94 The inlet surface of the optical-path pipe 44
96 Printed circuit board
98,100 Piece of a half rate of an optical-path pipe
102 Pin
104 Hole
106 Hole
108 Reflecting layer
110 Film

DRAWINGS

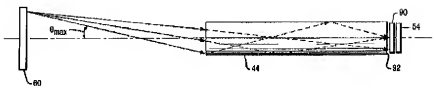
Drawing 1



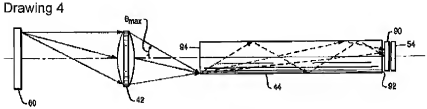
Drawing 2



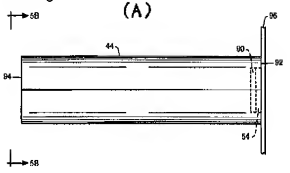
Drawing 3

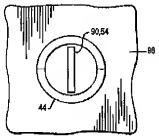


Drawing 4

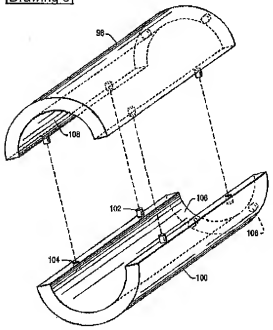


Drawing 5





[Drawing 6]



Drawing 7